BREAKDOWN TEST SET
METRO-TEL
MT14103L5
SHOP

Fig. 1—GB-14103 List 5 Test Set

read directly from the upper scale (0-2000 OHMS) of the meter; with the key in the RX1000 position the resistance across the pair is 1000 times the reading on the upper scale (0-2 MEGOHMS) of the meter. With the key in the mid-position, the current flow from the breakdown battery can be read directly on the lower scale (0-5 amperes) of the meter.

A special line cord 30 feet long is provided having a plug at one end and Universal test clips at the other end. A second cord having plugs at each end is provided for use in testing the individual 45 volt batteries. Storage space for the cords is available in the cover of the set.

Slots in the detail separating the battery compartment from the instrument panel permit the cover to be closed with the line cord connected for unattended buzzer operation.

A folding handle is provided at the rear of the box to permit hanging the set on a pole step.

Auxiliary battery for Wheatstone bridge measurements can be obtained from the BRDG-BAT binding posts on the set. This voltage is controlled by the selector switch, in steps from 4.5 to 90. The REV key can be used as a battery reversing key when the bridge is being employed for locating opens.

The ADJUST O knob is used for adjusting the ohmmeter. With the line cord clips short-circuited and the AMPS key in the RX1000 or the R x 1 position turn the knob until the ohmmeter reads zero.

The fuse in the meter circuit is to protect the meter in the event that the keys are improperly thrown.

MAINTENANCE

Batteries: The 45 volt batteries in the set should be tested about twice a month and at any other time when their condition is doubtful. This test is made by short-circuiting the breakdown set leads, inserting the plug into the LINE jack and then with the 630V switch operated to the ON position, momentarily throwing the OHMS key to the BRKDWN position. If the current flow is less than from 1-1/2 to 2 amperes and the batteries have given reasonable service, they should be discarded. If they have been in use only a short time and there is reason to suspect that only a few of the batteries are depleted, they should be tested individually as described below.

To test the individual 45 volt batteries remove the battery cable plug from the battery to be tested and insert the special test cord. The other end of the test cord should be plugged into the LINE jack. Then with the LINE SHORT key operated to $\pm$ and the 630V switch to OFF, throw the OHMS key momentarily to BRKDWN position. If the current flow is less than 1-1/2 amperes the battery should be replaced.

To test the 4-1/2 volt batteries connect a suitable voltmeter across the terminals marked BRDG and BAT. Then short-circuit the clips of the line cord, set the selector switch to 9 volts and operate the OHMS key to BUZ. If the reading on the voltmeter is less than 6.5 volts the batteries should be replaced.

The 1-1/2 volt Eveready No. W354 battery should be changed when the ohmmeter in the test set can not be adjusted to zero.

Fuse: The 1/32 ampere Littel fuse 361.031, in the meter circuit is located under the instrument panel which must be removed to change it.

METRO-TEL CORP.

GB-14103-L3 TEST SET

INTRODUCTION - GENERAL

The GB-14103 Test Set is intended for use in locating high resistance faults resulting from moisture in exchange cables. The test set is used as a tone source for fault location and employs a 500-cycle buzzer to take full advantage of the characteristics of the amplifiers with which it is used (generally, the Western Electric Co. 147A or 107A amplifiers).

The primary use of the set is to reduce the fault resistance between the defective wires to permit running down the fault with tone and an exploring coil. Most faults can be broken down as a short on one pair and the set should, if possible, be used on this basis. If the fault can not be broken down as a short, the set can then be used to break down the fault as a cross between two pairs.

The GB-14103 Test Set must not be connected between one side of a pair and ground.

If a Wheatstone bridge location has been made, the set will be found helpful when the fault resistance is too high to permit running down the fault with tracing tone and an exploring coil.

The GB-14103 Test Set can be used to advantage in cases where the entire cable is out of service or where a Wheatstone bridge location can not be made.

DESCRIPTION

The set contains a group of batteries connected in series to provide 630 volts output, a cutoff switch in series with the 630 volts, a switch for applying this voltage across the two defective wires, a key for reversing the polarity of the battery, a buzzer for use as a source of exploring coil tone with a key for making it continuous or intermittent. A meter is provided for reading the current through the fault, checking the resistance of the faulty pair before and after the trouble is broken down and for testing the batteries in the set.

BATTERY COMPLEMENT (Not Furnished With Set)

QTY.	VOLTAGE	TYPES
15	45 Volts	Eveready #738 or NEDA 205 Burgess Z30
2	4 1/2 Volts	Eveready #714
1	1 1/2 Volts	Eveready #711 or NEDA 700 RCA VS101

The voltage of the buzzer circuit can be varied in steps from 4.5 to 90 by means of the selector switch. By switching the TONE key, either continuous or intermittent buzzer tone can be applied.

The OHMS key applies breakdown voltage to the defective pair when operated to BRKDWN (non-locking) position. When operated to BUZ (locking) position, tone is applied to the defective pair after the fault has been broken down. This key must be in the center position when the ohmmeter circuit is used.

The LINE SHORT key is a three-position battery reversing key which in the mid-position disconnects the test set circuit from the line socket and short-circuits the pair. The forward and back positions are used to reverse the test set connections to the LINE jack. When making a breakdown test these positions are used to reverse the polarity of the battery being applied to the line.

The AMPS key (non-locking) controls the meter circuit. When this key is in the R x 1 position the resistance across the pair can be

CONNECTING SET TO CONDUCTORS

The general location of the fault should be determined by analysis of the pair count affected or by Wheatstone bridge measurements. The resistance between wires can be measured using the meter in the test set.

The breakdown set should be applied as near to the fault as practicable, if its general location can be determined.

The pairs or pairs having the lowest fault resistance (as a short) should be used for the test, if possible. If the fault can not be broken down using individual pairs, the sides of the two pairs having the lowest insulation resistance between them can be used.

PRECAUTIONS

Before a breakdown test is made, the pair or pairs involved shall be isolated from the central office equipment either by removing the cross-connections at a cross-connecting terminal or by removing the heat coils at the central office. In the latter case, the protector blocks of the test pair or pairs should be replaced with a B Warning Marker to warn central office personnel that breakdown tests are in progress. Warning markets should not be removed, nor should the pair or pairs be restored to normal until the tests are completed. The subscriber or subscribers on the pair or pairs under test should be notified before service is interrupted.

The following precautions should be taken at all terminal appearances of the pair or pairs under test:

(1) Disconnect all stations and remove the protectors associated with the pair or pairs on which the breakdown test is to be made. Do not go across a test pair or pairs without first making a listening test, using a condenser in series with the talking set. This will prevent disturbing a working circuit in case the test pair is incorrectly marked in a terminal.

(2) Disconnect all dead loops or other wires associated with the pair or pairs.

(3) Rearrange any wires that are in contact with the binding posts of the pair or pairs under test.

(4) Determine whether the pair or pairs terminate in a flexible insulated form.

(5) Depending on the nature of the termination, at each appearance cover the tip and ring terminals of the pair or pairs and also any fuse mountings with a B Binding Post Cap or with a No. 1, No. 2 or No. 3 Binding Post Insulator. Then tie a linen tag on which is written 'Breakdown Test,' together with the date, on one of the caps or insulators at each appearance, except at the location where the breakdown voltage is applied. It is important that the tag and the string be so placed that they are not in contact with any binding posts in the terminals as a high resistance fault might result due to dampness at some later date.

If the pair or pairs terminate in a textile form (including the central office form) and if a bridge measurement or pair analysis has not definitely eliminated the possibility that the fault may be in the form, make the breakdown test from this point, or station a workman there to observe for evidence of breakdown. If the breakdown test is made at the form and there is no evidence of breakdown in the form, the set can then be applied at a distribution terminal without stationing a workman at the textile form.

The workman making the test shall call the test desk to determine whether any other men are working in the cable (at locations other than terminals) in the section to which the breakdown voltage will be applied. These men should be advised to suspend work locations. The breakdown battery shall not be applied to any cable in which there are temporary openings unless the openings are tightly wrapped. At underground locations the workman should be advised to stay out of the manhole while the test is under way.

The 630V switch should be in the OFF position except when the high voltage is being applied.

One completion of the breakdown test it is customary for the workman to notify test desk or cable locating bureau who will notify any men working in the cable that the tests have been completed.

TESTING PROCEDURE

The set should preferably be operated in a car or truck. If this is impracticable, place the set on a rubber blanket or B Splice Covering on the ground.

With the protectors removed and the conductors dressed away from pair under test connect the test clips of the Test Set Line Cord to the pair or sides of the pairs under test and then insert the plug into the line jack on the breakdown set. Then measure the resistance of the fault.

At pole mounted terminals clear pair under test by removing drop wires, and bridle wire to protectors.

Set the voltage adjustment switch (0 to 90 volts) at 22-1/2 volts. As soon as the buzzer operates after breakdown, reduce the voltage to the lowest value that will maintain buzzer operation. This will minimize interference on adjacent circuits and will reduce the likelihood of the tone carrying beyond the fault. It will also minimize damage to the buzzer contacts.

Operate the 630V switch to the ON position.

With the LINE SHORT key locked in the forward $\pm$ position, apply voltage to the line by operating the OHMS key momentarily to the BRKDWN position. Then release the OHMS key and move the LINE SHORT key to the back $\pm$ position. Again operate the OHMS key to the BRKDWN position. The OHMS key should be held each time for about 1/2 second. Longer application of the breakdown potential usually tends to clear the fault and will reduce the effective life of the batteries.

Continue to operate the two keys in this manner throughout the test. DO NOT change the position of the LINE SHORT key while the OHMS key is in the BRKDWN position, as the heavy current flow may damage the key contacts.

When the fault breaks down, current will flow through the fault and the meter will show a steady reading of 1 ampere or more. When this occurs, immediately throw the OHMS key to the BUZ position and reduce the buzzer voltage to the lowest practicable value. Leave the LINE SHORT key in either the forward or back position.

If the buzzer operates, throw the 630V switch to the OFF position.

If the buzzer does not operate, apply the breakdown voltage again to the line to break down the fault. If the buzzer fails to operate after the fault breaks down again as indicated on the meter, set the voltage adjustment switch to 90 volts and repeat the test.

If the fault does not break down after about 25 applications of the high voltage, adjust the 'O' position of the ohmmeter with the AMPS key in the R x 1000 position and then check the resistance of the fault to determine whether it has increased or decreased. If the fault resistance has decreased, resume operations on the same pair. If it has increased, transfer operations to another pair after the necessary precautions have been taken.

If operations on the second pair are not successful try a third pair.

Sometimes the fault can be broken down by applying the voltage from another terminal.

If the fault can not be broken down by applying 630-volt potential between the wires of a pair, apply the breakdown potential between the sides of two pairs having the lowest insulation resistance, after the

necessary precautions on the two pairs have been taken. If operations on these wires are not successful try the other wires of these pairs or other pairs.

As soon as the trouble breaks down, as indicated by the operation of the buzzer, check the resistance of the wires. To do this adjust the 'O' position of the ohmmeter with the AMPS key in the R x 1 position and then measure the resistance of the fault.

The approximate distance to the fault can then be calculated by multiplying its resistance (in ohms) by the feet-per-ohm value of the conductors and dividing by two.

Gayge of Cable	Approx. Loop Feet per Ohm
19	60
22	30
24	20
26	12

With the buzzer operating, the exact location of the fault can be determined by the exploring coil method. First listen to the tone of the cable in both directions from the set. If the tone is heard in both directions reduce the buzzer voltage until the tone is heard in only one direction. If the set is left unattended, place the cord in the slots provided for that purpose, put the cover on and suspend the set from a pole step by the folding handle provided on the back of the set.

After the fault has been located, turn the keys to their normal position and disconnect test set.

Any circuits working on the pair or pairs should be restored to service. The B Binding Post Caps and the tags should be removed at the working appearances.

WARNING

BEFORE USING SET ON A CABLE PAIR BE CERTAIN THAT THE PAIR IS ISOLATED AT CENTRAL OFFICE AND AT TERMINALS. BE CERTAIN OTHER MEN ARE NOT WORKING ON CABLE. APPLY HIGH VOLTAGE ONLY BETWEEN WIRES OF A PAIR, NEVER TO GROUND OR BETWEEN WIRES OF DIFFERENT PAIRS. ALWAYS HAVE "630V" SWITCH IN "OFF" POSITION EXCEPT WHEN ACTUALLY APPLYING HIGH VOLTAGE.

WIRE RESISTANCE TABLE
AT 68° F

GAUGE	APPROX. FEET PER OHM	APPROX. OHMS PER 1000 FEET
19	125	8
22	62	16
24	40	26
26	25	42

TEST PROCEDURES FOR 14103 TYPE BREAKDOWN TEST SETS (GB14103, MT14103L5, KS14103, ETC.)

I. PHYSICAL

1) Remove battery compartment cover and discard batteries.

2) Remove 4 ea. screws holding control section and remove same.

3) Inspect the above section for the following:
- Meter damage
- Burnt components
- Broken wires
- Loose components
- Corrosion
- Burned sw. contacts
- Sluggish or inoperative controls (Ohms key should not latch)
- Fuse to be eliminated if not already done
- Obscured panel markings
- Clean, repair, or replace as necessary

4) Inspect case and lid for the following:
- Dents
- Rust
- Leakage residue
- Damaged or missing battery liner

5) Inspect test cable for the following:
- Intermittant or open leads
- Worn or damaged clips and boots
- Corrosion or damage to plug contacts
- Clean, repair, or replace as necessary

6) Install control section and fasten with 4 ea. screws

7) Install fresh batteries. (CAUTION: 640 VOLTS AVAILABLE AT OUTPUT TERMINAL!)

II. FUNCITONAL

A. Voltage

1) Connect DCVM between case and one output cable clip

2) Set up 14103 as follows:
- 630V sw. on
- Line short sw. operated to +/-
- Voltage sw. D1 to zero
- All other controls normal

3) Operate sw. K4 to brkdwn position, and check for voltage leak to case.
NOTE: A few inductive volts is normal (less than 20 w/Fluke 77).

4) Change line short sw. to -/+ position and repeat Step 3.

5) Move DCVM to the other output cable clip and repeat Steps 3 and 4.

6) Connect DCVM to both output clips, operate K4 to brkdwn, voltage should exceed 620 VDC. Release K4 sw.

7) Short output cable clips, momentarily operate K4 to brkdwn and observe about 5 amps on 14103 meter.

8) Turn 630v sw. to off and remove DCVM.

B. OHMS

1) Short output cable clips.

2) Operate line short sw.

3) Operate adjust ohms pot for full scale meter deflection in both Rx1 and Rx1000 modes.

4) Using decade resistance box, check tracking at 50 OHMS on low range, and 50K OHMS on hi range. TOL is +/- 5%.

5) Remove resistance box and restore all keys to normal.

C. BUZZER

1) Connect butt set to output cable, talk mode.

2) Operate line short sw.

3) Operate K4 to buzz position.

4) Operate voltage sw. D1 to 22.5v position.

5) Hear audible tone (int or cont) thru butt set.

6) Check remaining positions of D1 for tone. (45v thru 90v)
NOTE: On some solid state tone mods. (such as Teldesign Inc.) no sound will be heard without butt-set connected to output. Also, a load resistance is necessary at the output. (Talk-mode of butt set). No tone is available in 4.5 and 9.0 positions on D1. (Older, un-modified sets have a mechanical buzzer and two 4.5v batteries, and will tone in 4.5 and 9.0 modes.)

7) Connect DCVM to bridge bat terminals at upper left of test set.

8) Find voltages corresponding to D1 setting (22.5v thru 90v). With D1 set to 90V push rev button and find opposite polarity. (With DCVM on output cable a slightly lower voltage will be found).

9) Remove butt-set and restore all controls to normal.

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